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DEPARTMENT OF TRANSPORTATION

12/12/97

Federal Aviation Administration

[14 CFR Part 25]

[Docket No.     ; Notice No.     ]

RIN 2120-

**Revision of Braking Systems Airworthiness Standards to Harmonize with European Airworthiness Standards for Transport Category Airplanes.**

**AGENCY:** Federal Aviation Administration, DOT.

**ACTION:** Notice of proposed rulemaking.

**SUMMARY:** The Federal Aviation Administration proposes to revise the airworthiness standards for transport category airplanes to harmonize braking systems design and test requirements with standards proposed for the European Joint Aviation Requirements (JAR). These proposals were developed in cooperation with the Joint Aviation Authorities (JAA) of Europe and the U.S. and European aviation industry through the Aviation Rulemaking Advisory Committee (ARAC), and are intended to benefit the public interest by standardizing certain requirements, concepts, and procedures contained in the airworthiness standards without reducing, but potentially enhancing, the current level of safety.

**DATES:** Comments must be received on or before [ insert date 90 days after date of publication in the Federal Register ].

**ADDRESSES:** Comments on this notice may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-200), Docket No.     , 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No.     . Comments may also be sent electronically to the following internet address: 9-NPRM-CMTS@faa.dot.gov.

Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), Federal Aviation Administration, Northwest Mountain Region, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

**FOR FURTHER INFORMATION CONTACT:** Mahinder K. Wahi, FAA, Propulsion/Mechanical/Cabin Safety Branch, ANM-112, Transport Airplane Directorate, 1601 Lind Avenue SW., Renton, WA 98055-4056; telephone (425) 227-2142; facsimile (425) 227-1320.

**SUPPLEMENTARY INFORMATION:**

**Comments Invited**

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which is stated:

"Comments to Docket No. . " The postcard will be date stamped and returned to the commenter.

#### **Availability of the NPRM**

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5948).

Internet users may reach the FAA's web page at <http://www.faa.gov> or the Federal Register's web page at [http://www.access.gpo.gov/su\\_docs](http://www.access.gpo.gov/su_docs) for access to recently published rulemaking documents.

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration (FAA), Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267-9680. Communications must identify the notice number or docket number of this notice. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

#### **Background**

The airworthiness standards for transport category airplanes are contained in 14 CFR part 25. Manufacturers of transport category airplanes must show that each airplane they produce of a different type design complies with the relevant standards of part 25. These standards apply to airplanes manufactured within the U.S. for use by U.S.-registered operators and to airplanes manufactured in other countries and imported under a bilateral airworthiness agreement.

In Europe, the Joint Aviation Requirements (JAR) were developed by the Joint Aviation Authorities (JAA) to provide a common set of airworthiness standards for use within the European aviation community. The airworthiness standards for European type certification of transport category airplanes, JAR-25, are based on part 25 of Title 14. Airplanes certificated to the JAR-25 standards, including airplanes manufactured in the U.S. for export to Europe, receive type certificates that are accepted by the aircraft certification authorities of 23 European countries.

Although part 25 and JAR-25 are very similar, they are not identical. Differences between the FAR and the JAR can result in substantial additional costs when airplanes are type certificated to both standards. These additional costs, however, frequently do not bring about an increase in safety. For example, part 25 and JAR-25 may use different means to accomplish the same safety intent. In this case, the manufacturer is usually burdened with meeting both requirements, although the level of safety is not increased correspondingly. Recognizing that a common set of standards would not only economically benefit the aviation industry, but would also maintain the necessary high level of safety, the FAA and JAA consider harmonization to be a high priority.

In 1988, the FAA, in cooperation with the JAA and other organizations representing the American and European aerospace industries, began a process to harmonize the airworthiness requirements of the United States and the airworthiness requirements of Europe, especially in the areas of Flight Test and Structures.

#### **The Aviation Rulemaking Advisory Committee**

The Aviation Rulemaking Advisory Committee (ARAC) was formally established by the FAA on January 22, 1991 (56 FR 2190) to provide advice and recommendations concerning the full range of the FAA's safety-related rulemaking activity. This advice was sought to develop better rules in less overall time using fewer FAA resources than are currently needed. The committee provides the opportunity for the FAA to obtain

firsthand information and insight from interested parties regarding proposed new rules or revisions of existing rules.

There are 64 member organizations on the committee, representing a wide range of interests within the aviation community. Meetings of the committee are open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act.

The ARAC establishes working groups to develop proposals to recommend to the FAA for resolving specific issues. Tasks assigned to working groups are published in the Federal Register. Although working group meetings are not generally open to the public, all interested parties are invited to participate as working group members. Working groups report directly to the ARAC, and the ARAC must accept a working group proposal before that proposal can be presented to the FAA as an advisory committee recommendation.

The activities of the ARAC will not, however, circumvent the public rulemaking procedures. After an ARAC recommendation is received and found acceptable by the FAA, the agency proceeds with the normal public rulemaking procedures. Any ARAC participation in a rulemaking package will be fully disclosed in the public docket.

Starting in 1992, the FAA harmonization effort for various systems related airworthiness requirements was undertaken by the ARAC. A working group of industry and government braking systems specialists of Europe, the United States, and Canada was chartered by notice in the Federal Register (59 FR 30080, June 10, 1994). The working group was tasked to develop a harmonized standard, such as a Technical Standard Order (TSO), for approval of wheels and brakes to be installed on transport category airplanes and to develop a draft notice of proposed rulemaking (NPRM), with supporting economic and other required analyses, and/or any other related guidance material or collateral documents, such as advisory circulars, concerning new or revised

requirements and the associated test conditions for wheels, brakes and braking systems, installed in transport category airplanes (§§ 25.731 and 25.735). The JAA is to develop a similar proposal to amend JAR-25, as necessary, to achieve harmonization.

The rulemaking proposal contained in this notice is based on a recommendation developed by the Braking Systems Harmonization Working Group, and presented to the FAA by the ARAC as a recommendation.

### **Discussion of the Proposals**

The FAA proposes to amend 14 CFR §§ 25.731 and 25.735 to harmonize these sections with JAR-25. The JAA intends to publish a Notice of Proposed Amendment (NPA), also developed by the Braking Systems Harmonization Working Group, to revise JAR-25 as necessary to ensure harmonization in those areas for which the proposed amendments differ from the current JAR-25, Change 14. When published, the NPA will be placed in the docket for this rulemaking.

Generally, the FAA proposes to: (1) add appropriate existing JAR requirements to achieve harmonization; (2) move some of the existing regulatory text, considered to be of an advisory nature, to an advisory circular; (3) add regulations addressing automatic brake systems, brake wear indicators, pressure release devices, and system compatibility; and (4) consolidate and/or separate requirement subparagraphs for clarity.

A new proposed Advisory Circular (AC) 25.735-1X, Brakes and Braking Systems Certification Tests and Analysis, has been developed by the ARAC Harmonization Working Group to ensure consistent application of these proposed revised standards. Public comments concerning AC 25.735-1X are invited by separate notice published elsewhere in this issue of the Federal Register. The JAA intends to publish an Advisory Material Joint (AMJ), also developed by the Harmonization Working Group, to accompany their NPA. The proposed AC and the proposed AMJ contain harmonized advisory information.

A new proposed TSO-C135 has also been developed by the Harmonization Working Group as a harmonized standard for approval of transport airplane wheels and wheel and brake assemblies to replace applicable parts of the existing TSO-C26c, Aircraft Wheels and Wheel-Brakes Assemblies, dated May 18, 1984. Public comments concerning TSO-C135 are invited by separate notice published elsewhere in this issue of the Federal Register. The JAA intends to adopt TSO-C135 as Joint Technical Standard Order (JTSO)-C135 and publish it to accompany their NPA.

#### **Discussion of Proposals in this NPRM**

**Proposal 1.** The FAA proposes to revise the current heading of § 25.735, "Brakes," to read, "§ 25.735 Brakes and braking systems."

**Discussion:** This section covers not only the brakes and their performance requirements and safety considerations, but also provides requirements for the systems and equipment associated with the brakes. As examples, the proposed additional paragraph (b)(2) refers to the brake hydraulic system and the hydraulic fluid supplying the brakes, and the proposed paragraph (e) refers to the antiskid system. The proposed change is of an editorial nature only, and consequently would have no impact on the current level of safety.

**Proposal 2.** The FAA proposes to add a heading to and revise the text of § 25.735(a) to read, "(a) Approval. Each assembly consisting of a wheel(s) and brake(s) must be approved."

**Discussion.** The current § 25.735(a), which states that each brake must be approved, is considered incomplete. Although a wheel not associated with a brake (non-braked) may be approved on its own per the applicable TSO, a brake approval is always considered in combination with its associated wheel(s) (i.e., for a combined wheel(s) and brake(s) assembly). The proposed change is of an editorial nature only and therefore would have

no impact on the current level of safety. Applicable advisory information would be included in proposed AC 25.735-1X.

**Proposal 3.** The FAA proposes to add the heading "Brake system capability" to § 25.735(b), to separate and revise the current text of the first sentence of § 25.735(b) into §§ 25.735(b) and (b)(1), and to delete the current text of the entire second sentence to read, "(b) Brake system capability. The brake system, associated systems and components must be designed and constructed so that: (1) if any electrical, pneumatic, hydraulic or mechanical connecting or transmitting element fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airplane to rest with a braked roll stopping distance of not more than two times that obtained in determining the landing distance as prescribed in § 25.125."

**Discussion:** The current text of the first sentence of § 25.735(b) reads, "The brake systems and associated systems must be designed and constructed so that if any electrical, pneumatic, hydraulic, or mechanical connecting or transmitting element (excluding the operating pedal or handle) fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airplane to rest under conditions specified in § 25.125 with a mean deceleration during the landing roll of at least 50 percent of that obtained in determining the landing distance as prescribed in that section."

Under this proposal, the term "components" would be added to the terms "brake system and associated systems" to make it more comprehensive. The parenthetical phrase "(excluding the operating pedal or handle)" would be deleted because no justification could be found for such an exclusion. The words "braked roll stopping distance" would be inserted in place of "landing roll" to clarify that the requirement refers only to the distance covered while the brakes are applied. The change from "at least 50 percent mean deceleration" to "not more than two times the landing distance" is intended to eliminate any possible confusion between "mean" and "average" deceleration, and to

state the requirement more clearly in terms of its real intent. The other changes in text are editorial and are made for clarity.

The current second sentence reads "Subcomponents within the brake assembly, such as brake drum, shoes, and actuators (or their equivalents), shall be considered as connecting or transmitting elements, unless it is shown that leakage of hydraulic fluid resulting from failure of the sealing elements in these subcomponents within the brake assembly would not reduce the braking effectiveness below that specified in this paragraph." The current second sentence would be removed and, due to its advisory content, included as guidance material in proposed AC 25.735-1X.

The proposed changes are clarifications of current regulations and the associated terminology and therefore would have no impact on the current level of safety.

Applicable advisory information would be included in proposed AC 25.735-1X.

**Proposal 4.** The FAA proposes to add a new § 25.735(b)(2) that would contain the intent and content of the ACJ 25.735(b) of JAR-25 regarding protection against fire resulting from hydraulic fluid leakage, spillage, or spraying on hot brakes. The proposal would state that, "(2) Fluid lost from a brake hydraulic system, following a failure in, or in the vicinity of, the brakes, is insufficient to cause or support a hazardous fire on the ground or in flight."

**Discussion.** Although the proposed requirement was previously included in ACJ 25.735(b) as acceptable means of compliance and interpretative material, it is now thought more appropriate that these practices should be considered as requirements as they have generally been treated as such in the past by both airplane manufacturers and regulatory authorities. The current level of safety would not be affected by this proposed change as it would adopt an existing industry practice. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 5. The FAA proposes to add the heading "Brake controls" to § 25.735(c), and to separate and revise the current text of § 25.735(c) into §§ 25.735(c) and (c)(1) to read, "(c) Brake Controls. The brake controls must be designed and constructed so that: (1) Excessive control force is not required for their operation."

Discussion: The current text reads, "Brake controls may not require excessive control force in their operation." The proposed changes are clarifications of current regulations and the associated terminology and therefore the current level of safety would not be impacted. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 6. The FAA proposes to add a new § 25.735(c)(2) to read, "(2) If an automatic braking system is installed, means are provided to (i) arm and disarm the system, and (ii) allow the pilot(s) to override the system by use of manual braking."

Discussion. The intent and content of the proposed changes have generally been adopted in the design of current automatic braking systems and are currently included in FAA Order 8110.8, "Engineering Flight Test Guide for Transport Category Airplanes," as interpretative and acceptable means of compliance. Consequently, both the airplane manufacturers and the regulatory authorities have generally considered them as standard practices; therefore, they would not impact the current level of safety. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 7. The FAA proposes to amend § 25.735(d) by adding the heading, "Parking brake," and by modifying the current text from, "The airplane must have a parking control that, when set by the pilot, will without further attention, prevent the airplane from rolling on a paved, level runway with takeoff power on the critical engine," to "(d)

Parking brake. The airplane must have a parking brake control that, when selected on, will, without further attention, prevent the airplane from rolling on a dry and level paved runway when the most adverse combination of maximum thrust on one engine and up to maximum ground idle thrust on any, or all, other engine(s) is applied. The control must

be suitably located or be adequately protected to prevent inadvertent operation. There must be indication in the cockpit when the parking brake is not fully released.”

**Discussion:** Introduction of the word "brake" before "control" clarifies that the paragraph refers to the means provided to the flightcrew for the application of the wheel brakes in the airplane parking mode. By revising the text, as proposed, the requirement would be enhanced to cover not only the case of a single engine takeoff thrust check with all other engines stopped, but would also cover an equally if not more probable case where any or all other engines are operating and producing up to a maximum ground idle thrust. The proposal also clarifies the extent of the takeoff thrust to be considered for the "critical" engine as the maximum that can be achieved, and by implication also requires the relevant thrust cases for remaining engine(s) according to the environmental circumstances that are dictated for the achievement of the maximum takeoff thrust on the critical engine. The word "dry" is added solely for clarification of the current understanding of this requirement.

The requirement for suitable location or protection against inadvertent operation of the parking brake control is derived from the current ACJ 25.735(d) of JAR-25 and is introduced because it is believed that such considerations should be regarded as requirements, and have generally been treated as such in the past by both airplane manufacturers and regulatory authorities. The additional requirement for cockpit indication when the parking brake is "not fully released" is to caution the pilot against a takeoff with the parking brake set. The proposed changes potentially enhance the current level of safety by clarifying intent and addressing some critical cases. Applicable advisory material would be included in proposed AC 25.735-1X.

**Proposal 8.** The FAA proposes to add the heading "Antiskid system" to § 25.735(e), to delete the current text “no single probable malfunction will result in a hazardous loss of

braking ability or directional control of the airplane” as being superfluous, and in order to facilitate the introduction of the new proposed §§ 25.735(e)(1) and (e)(2) under proposals 9 and 10 respectively, revise the remaining current text to read,

"(e) Antiskid system. If an antiskid system is installed:"

Discussion: The current § 25.735(e) reads: "If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction will result in a hazardous loss of braking ability or directional control of the airplane." The reference to antiskid devices and associated systems would be changed to "antiskid system," this being more appropriate to the paragraph's intent. The term "probable" was incompatible with the terminology of § 25.1309 because a "probable" malfunction cannot be associated with either major or hazardous effects and, if used in the "§ 25.1309" sense, could lead to a requirement that could be seen as less severe than § 25.1309 for that specific failure condition, with no obvious technical/state of the art reasons. It appears that the terminology (probable and hazardous) used was probably not "§ 25.1309 related" when the requirement was first introduced. Rather than trying to define the words, it is considered that the requirement is adequately covered by § 25.1309 and the current § 25.735(e) is superfluous. The proposed changes are of a clarifying and an editorial nature only and therefore would have no impact on the current level of safety.

Appropriate advisory material would be included in proposed AC 25.735-1X.

Proposal 9. The FAA proposes to add a new § 25.735(e)(1) to read, "(1) It must operate satisfactorily over the range of expected runway conditions, without external adjustment".

Discussion: The intent and content of the proposed changes are currently included in FAA Order 8110.8, "Engineering Flight Test Guide for Transport Category Airplanes," as interpretative material and acceptable means of compliance and are deemed appropriate to be adopted as requirements. Both the airplane manufacturers and the regulatory authorities have, in the past, considered them as standard practices; therefore,

they would not impact the current level of safety. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 10. The FAA proposes to add a new § 25.735(e)( 2) to read, "(2) It must, at all times, have priority over the automatic braking system, if installed."

Discussion: The intent and content of the proposed change is currently included in FAA Order 8110.8, "Engineering Flight Test Guide for Transport Category Airplanes," as interpretative material and acceptable means of compliance and is deemed appropriate to be adopted as a requirement. Both the airplane manufacturers and the regulatory authorities have, in the past, considered it as a standard practice; therefore, it would not impact the current level of safety. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 11. **(Note: This item proposes changes to amendments proposed in NPRM 93-8, Improved Standards for Determining Rejected Takeoff and Landing Performance. Publication of that amendment is expected soon. In the event that this rulemaking should proceed to publication before the RTO amendment, this proposal will be rewritten to address the current FAR/JAR.)**

The FAA proposes to amend § 25.735(f) by adding the heading "Kinetic energy capacity," by consolidating the requirements of current paragraphs (f) and (h), by adding similar requirements for a high energy landing condition, by removing paragraphs (f)(1) and (2), and paragraphs (h)(1), and (2), and by revising the text to read:

**"(f) Kinetic energy capacity.** The design landing stop, the maximum kinetic energy accelerate-stop, and the most severe landing stop brake kinetic energy absorption requirements of each wheel and brake assembly must be determined. It must be substantiated by dynamometer testing that, at the declared fully worn limit(s) of the brake heat sink, the wheel and brake assemblies are capable of absorbing not less than these

levels of kinetic energy. Energy absorption rates defined by the airplane manufacturer must be achieved. These rates must be equivalent to mean decelerations not less than 10  $\text{fps}^2$  for the design landing stop and 6  $\text{fps}^2$  for the maximum kinetic energy accelerate stop. The most severe landing stop need not be considered for extremely improbable failure conditions or if the maximum kinetic energy accelerate-stop energy is more severe. Design landing stop is an operational landing stop at maximum landing weight. Maximum kinetic energy accelerate-stop is a rejected takeoff for the most critical combination of airplane takeoff weight and speed. Most severe landing stop is a stop at the most critical combination of airplane landing weight and speed.

Discussion: The current paragraphs (f) and (h) state that the brake kinetic energy capacity ratings may not be less than the determined energy absorption requirements. The proposed paragraph (f) would require the calculation of the necessary energy absorption capacity, and require dynamometer test substantiation of the capability of the wheel and brake assemblies to absorb the energy at not less than specified rates. Usually, brakes are sized to exceed the calculated energy absorption requirements (i.e., their capacity exceeds the requirements, hence the heading "Kinetic energy capacity"). The term "rating" would be deleted because it is more relevant to the TSO than to the regulation. The proposed change would encompass the requirements of current paragraph (h) without the need for complete duplication of text.

The term "rejected takeoff" used under current paragraph (h) would be replaced with "accelerate-stop" for compatibility with § 25.109 terminology; and the term "most severe landing stop" would be added to address cases such as emergency return to land after takeoff, where the brake energy for a flaps up landing may exceed that corresponding to the accelerate-stop energy. For the accelerate-stop and the most severe landing stop, it is intended that the initial brake temperature resulting from previous brake use must be accounted for as specified in paragraphs 3.3.3.3 and 3.3.4.3 in the proposed

TSO-C135. It should be noted that the consideration for the initial temperature (in terms of residual energy) reflects an existing British Civil Aviation authority (CAA) Specification 17 requirement. Changing the term "main wheel-brake assemblies" to "wheel and brake assemblies," ensures the paragraph's applicability to any wheels fitted with brakes (i.e., includes the possibility of nose wheel brakes, etc.) and further ensures the understanding that the absorption requirements apply to the wheel and brake assembly. The substantiation statement requires that the wheel and brake assemblies be capable of absorbing the calculated levels of kinetic energy at the fully worn limit and that the energy absorption capability substantiation testing be conducted on the dynamometer.

The current §§ 25.735(f)(1) and (h)(1) would be incorporated in proposed AC 25.735-1X, because their content is not strictly part of the requirement, but provides advice on the primary features that should be conservatively included in a rational analysis.

The current §§ 25.735(f)(2) and (h)(2) are not strictly the requirement, but advice on the method of energy calculation to be used. Consequently, these would be incorporated in proposed AC 25.735-1X.

Because the required energy capacity of each wheel and brake assembly must be determined, the need to refer to "designed unequal braking distributions" is no longer necessary and would be deleted.

The current level of safety would be retained and possibly enhanced by addressing the most severe landing stop condition. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 12. The FAA proposes to remove the current § 25.735(g) requirement.

Discussion: The current § 25.735(g) requirement states that when setting up the dynamometer test inertia, an increase in the initial brake application speed is not a permissible method of accounting for a reduced (i.e., lower than ideal) dynamometer mass. This method is not permissible because, for a target test deceleration, a reduction in the energy absorption rate would result, and could produce a performance different from that which would be achieved with the correct brake application speed. Such a situation is recognized and is similarly stated in the proposed new TSO-C135, which would provide an acceptable means for wheel and brake assembly approval under § 25.735(a), thus making current § 25.735(g) unnecessary. The proposed change consolidates existing requirements and deletes redundant wording, and therefore would not impact the current level of safety.

Proposal 13. The FAA proposes to add a new § 25.735(g), "Brake condition after high kinetic energy dynamometer stop(s)," to read, "Following the high kinetic energy stop demonstration(s) required by paragraph (f) of this section, with the parking brake promptly and fully applied for at least three (3) minutes, it must be demonstrated that for at least five (5) minutes from application of the parking brake, no condition occurs (or has occurred during the stop), including fire associated with the tire or wheel and brake assembly, that could prejudice the safe and complete evacuation of the airplane."

Discussion: Paragraph (g) would require that the parking brake be applied for a minimum of three minutes, which is considered to be the minimum period of time required to cover the brake's ability to maintain the airplane in a stationary condition to allow a safe evacuation.

The requirement also gives consideration to the fact that the flightcrew may not be aware of the condition of the brake assemblies at the commencement of the flight, nor of the condition of the brake and wheel assemblies following the braking maneuver.

Furthermore, the reason for the severe braking could encompass both airplane system and

engine failures or fires. It would therefore appear sensible that it should be demonstrated that neither during the stop, nor for a reasonable period of time after its completion, no condition(s) shall occur as a result of these maneuvers that could further prejudice the safe and complete evacuation of the airplane. On the basis that an evacuation may be determined as prudent or necessary, and that such an evacuation must be capable of completion, irrespective of the timely response of the emergency services, five minutes would appear to be a reasonable period of time for the associated brake systems and equipment to remain free from conditions that might prejudice or jeopardize the evacuation. It is proposed that this period should commence at the time of initial application of the parking brake, this being a time during which the possible need for evacuation and airport emergency services occurs following an accelerate-stop. The proposed changes provide for the additional demonstration of a safe condition following high energy absorption by the wheels and brakes, which was not previously required. Although previously approved brakes may have been able to comply with the requirement, approval could not have been refused had this not been the case. It is therefore believed that the proposed changes would provide a potential enhancement of the current level of safety. Applicable advisory material would be included in proposed AC 25.735-1X.

Proposal 14. The FAA proposes to add a modified version of the current JAR 25.735 (i) as new 14 CFR § 25.735(h), "Stored energy systems," to read as follows:

"(h) Stored energy systems. An indication to the flightcrew of usable stored energy must be provided if a stored energy system is used to show compliance with paragraph (b)(1) of this section. The available stored energy must be sufficient for:

(1) At least six (6) full applications of the brakes when an antiskid system is not operating; and,

(2) Bringing the airplane to a complete stop when an antiskid system is operating, under all runway surface conditions for which the airplane is certificated.”

Discussion: A full brake application is defined as an application from brakes fully released to brakes fully applied, and back to fully released. For those airplanes that may provide a number of independent braking systems, which are not "reliant" on a stored energy system for the demonstration of compliance with paragraph (b)(1) of this section, but which perhaps incorporate a stored energy device, this requirement is not applicable. It would be unreasonable that the requirement for a minimum energy capacity and the provision of means to indicate the level of stored energy to the flightcrew should be maintained, particularly if its failure would have a minimal consequence on airplane or passenger safety.

In the event that an hydraulic accumulator is used for energy storage and the gas pressurization depletes, a pressure indication alone as currently required in JAR 25.735(i) would be inadequate because it would not provide indication of such faults to the flightcrew. In fact, the current typical flight deck presentation could give a false sense of security to the crew because it would almost inevitably indicate a satisfactory pressure, regardless of the real situation. Consequently, the proposed rule would require a measure of the stored energy, rather than pressure, to be presented to the flightcrew.

The minimum level of stored energy required for the emergency/standby braking means would be presented as a requirement rather than as advisory material. In the majority of cases, this material has been used as a virtual requirement in the past by airplane manufacturers and regulatory authorities. The proposed change would potentially enhance the current level of safety because the FAA is proposing to adopt a common but not universal industry practice and an improvement over the existing JAR rule. Applicable advisory material would be included in the proposed new AC 25.735-1X.

Proposal 15. The FAA proposes to add a new § 25.735(i), "Brake wear indicators," to read as follows:

"(i) Brake wear indicators. Means must be provided for each brake assembly to indicate when the heat sink is worn to the permissible limit. The means must be reliable and readily visible."

Discussion: In order to ensure, as far as is practicable, that the brake heat sink is not worn beyond its allowable wear limits throughout its operational life, it is considered necessary to provide some device that can readily identify the fully worn limit of the heat sink. The proposal reflects a requirement included in a series of airworthiness directives issued between 1989 and 1994 to require establishment of brake wear limits and to provide means to indicate the same. The British Civil Aviation Authority (CAA) Specification No. 17 also specifies the provision of such an indicator, and the majority of wheel and brake assembly designs include such a device. The proposed rule would have no impact on the current level of safety, because the FAA is proposing to adopt an existing industry practice. Appropriate advisory information would be included in proposed AC 25.735-1X.

Proposal 16. The FAA proposes to add a new § 25.735(j), "Overtemperature burst prevention," a new § 25.731(d), "Overpressure burst prevention," and a new § 25.731(e), "Braked wheels," to read as follows:

"§ 25.735(j) Overtemperature burst prevention. Means must be provided in each braked wheel to prevent wheel failure and tire burst that may result from elevated brake temperatures. Additionally, all wheels must meet the requirements of § 25.731(d)."

"§ 25.731(d) Overpressure burst prevention. Means must be provided in each wheel to prevent wheel failure and tire burst that may result from excessive pressurization of the wheel and tire assembly."

“§ 25.731(e) Braked wheels. Each braked wheel must meet the applicable requirements of § 25.735.”

Discussion - § 25.735(j): There is an existing requirement (§ 25.729(f)) related to the protection of equipment in wheel wells against the effects of bursting tires and a similar requirement is stated in TSO-C26c, Wheels and Wheel-Brake Assemblies. JAR 25.729(f) requires protection of equipment on the landing gear and in wheel wells against tire burst and elevated brake temperatures, and a similar requirement is stated in the “Minimum Operational Performance Specification for Wheels and Brakes on JAR Part 25 Civil Aeroplanes” (document ED-69). However, there is no direct requirement in either part 25 or JAR-25 that means must be provided to prevent wheel failure and tire burst that could result from elevated brake temperatures. As a result, it has become an industry practice to incorporate pressure release device(s) that function as a result of elevated wheel temperatures to deflate the tires. Nevertheless, it is believed to be both reasonable and prudent that such a requirement should be clearly stated in the paragraph related to airplane brakes and braking systems. The proposed requirement for temperature activated devices would not impact the current level of safety. Applicable advisory information would be included in proposed AC 25.735-1X.

Discussion - § 25.731(d): Wheel failure and tire burst due to overinflation presents a hazard to ground personnel and the airplane. Certain airplane manufacturers require wheel pressure release devices that reduce this hazard. This is considered a safety issue requiring the incorporation of these devices. Incorporation of pressure release devices in tire inflation equipment is not considered adequate due to a history of misuse resulting in serious injuries or fatalities. Installation in the wheel reduces the potential for tampering or misuse and insures proper levels of protection. The proposed change would retain and potentially enhance the current level of safety. Applicable advisory information would be included in proposed AC 25.735-1X.

Discussion - § 25.731(e): § 25.731 contains regulations applicable to all airplane wheels. If the wheel is braked, additional regulations apply which are contained in § 25.735. Section 25.731(e) is added to provide a cross-reference to those additional requirements. The proposed change would retain and potentially enhance the current level of safety.

Proposal 17. The FAA proposes to add a new § 25.735(k), "Compatibility," to read as follows:

“(k) Compatibility. Compatibility of the wheel and brake assemblies with the airplane and its systems must be substantiated.”

Discussion: Reliable and consistent brake system performance can be adversely affected by incompatibilities within the system and with the landing gear and the airplane. As part of the overall substantiation of safe and anomaly free operation, it is necessary to show that no unsafe conditions arise from incompatibilities between the brakes and brake system with other airplane systems and structures. Areas such as antiskid tuning, landing gear dynamics, tire type and size, brake combinations, brake characteristics, brake and landing gear vibrations, etc., need to be explored and corrected if necessary. Therefore, this requirement is introduced to address these issues which are normally covered by airplane manufacturers during development of the airplane and must be addressed by modifiers of the equipment. Incorporation of this requirement would potentially enhance the current level of safety. Appropriate advisory information would be included in proposed AC 25.735-1X.

**Regulatory Evaluation, Regulatory Flexibility Determination, and Trade Impact Assessment**

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation

justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: (1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; (2) is not "significant" as defined in DOT's Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

#### Regulatory Evaluation Summary

Although numerous revisions would be made to FAR § 25.735, only one would impose additional quantified costs for both part 25 large and small airplane manufacturers (see proposal 11). One ARAC member, a manufacturer of part 25 small airplanes, asserted that proposals 7, 14, and 16 would also impose incremental costs, but provided no specific estimates. Essentially all of the changes codify current industry practice or conform FAR § 25.735 to corresponding sections of the JAR. Adoption of the proposed changes would increase harmonization and commonality between American and European airworthiness standards. Harmonization would eliminate unnecessary duplication of airworthiness requirements, thus reducing manufacturers' certification costs (6 substantive proposals out of 17 total in the subject NPRM would essentially mirror the proposed European standards; the 11 others would not differ significantly). The FAA believes the harmonization cost savings would exceed the relatively low incremental costs of the proposed rule (see Summary of Costs and Benefits section below).

Proposal 7. Changes regarding parking brake control and cockpit indication of the brake essentially reflect current industry practice for the majority of part 25

manufacturers; consequently, there are no expected incremental costs. As noted above, one manufacturer of part 25 small airplanes, however, indicated that its current designs do not meet this requirement and that costs for cockpit indication in future designs would, in fact, be incremental. The manufacturer, however, did not provide such costs to the FAA. The FAA invites that manufacturer (and/or other interested parties) to provide detailed cost estimates during the public comment period.

Proposal 11. One ARAC member, a manufacturer of part 25 large airplanes, notes that the average impact of the 10% residual RTO energy requirement would be a two to three percent increase in the brake's energy absorption requirements. Notwithstanding, this increase is smaller than the tolerances on its ability to define brake requirements and the brake manufacturer's conformance to the specifications. Also, higher residual energies would enable the manufacturer to raise its recommended brake temperatures for dispatch, so any potential higher brake costs would be offset by more efficient aircraft operation (shorter turnaround times, less time at gate waiting for brakes to cool).

The term "most severe landing stop" ("MSL") would be added to address cases such as immediate return to land after takeoff, where the brake energy for a flaps up landing may exceed that corresponding to the accelerate-stop energy. The MSL requirement, while a new FAA requirement, has been in effect in Europe (per British CAA); consequently, many large part 25 airplane manufacturers currently meet this standard. Notwithstanding, large part 25 airframe and brake manufacturers note that in almost all cases either the MSL stop energy would not exceed the maximum kinetic energy accelerate-stop energy or, the MSL stop condition is extremely improbable. One part 25 large airplane manufacturer, however, noted that demonstrating adherence to this requirement for its typical airplane model would add the equivalent of two additional

high energy dynamometer tests in which the test brake would be destroyed; estimated incremental one-time costs for this equal approximately \$60,000 per type certification. Another manufacturer, however, estimates only one test in the \$20,000 - \$40,000 range. Manufacturers of small part 25 airplanes would experience some incremental one-time testing costs totalling approximately \$20,000 per type certification.

The aforementioned nonrecurring costs for either the part 25 large or small airplane type certification would easily be offset by the harmonization cost savings cited earlier. Any potential safety benefits from avoiding even one minor accident would add to such benefits. The FAA, therefore, finds proposal 11 to be cost beneficial.

Proposal 14. As the stored energy requirement reflects current industry practice for most part 25 manufacturers, there would be no expected incremental costs associated with it. However, the same manufacturer (of part 25 small airplanes) that reported potential costs for proposal 7 also indicated that its current designs do not include usable stored energy indication, and compliance with this requirement in future designs would impose incremental costs; detailed cost estimates, however, were not provided. The FAA requests that the manufacturer (or others) provide detailed cost estimates during the public comment period.

Proposal 16. In the last several years, many wheel manufacturers have included pressure release devices in most new production wheels in order to avoid potential liability. Codification of existing industry practice would ensure that the enhanced level of safety is retained. There are no expected incremental costs associated with this proposal since it does reflect current industry practice. However, the same manufacturer (of part 25 small airplanes) that, in contrast to other manufacturers, reported potential costs for proposals 7 and 14 indicated that the requirement for wheel pressure release devices would also impose incremental costs in future designs. Again, the FAA invites

that manufacturer (or others) to provide detailed cost estimates during the public comment period.

#### Summary of Costs and Benefits

As delineated above, and barring more detailed information for proposals 7, 14, and 16, the FAA concludes that only proposal 11 would result in incremental costs attributable to the subject NPRM. Demonstrating adherence to the MSL requirement would increase nonrecurring testing costs from \$20,000 - \$60,000 for a part 25 large airplane type certification; the amount for a part 25 small airplane type certification is estimated to be \$20,000. According to one manufacturer, cost savings from harmonization, in terms of avoiding added costs of coordination and documentation, with the JAA and involving, for example, additional travel overseas, reports, etc., would be equal to or greater than the maximum incremental cost of \$60,000. The FAA believes that potential safety benefits resulting from specification of minimum accepted standards would supplement these cost-savings. Although there were numerous (approx. 170) accidents involving brake failures during landings in the period 1982-1995, none were determined to have been directly preventable by the subject provisions. Different designs in future type certifications, however, could present unexpected problems and raise future accident rates. This proposed rule is expected to reduce the chances of future accidents by codifying in the FAR (and therefore making mandatory) what was prevailing, but not necessarily universal, industry practice.

For the reasons specified, the FAA finds the proposed rule to be cost-beneficial.

#### Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if a proposed or final

rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA review requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost threshold, and "substantial number" as a number that is not less than eleven and that is more than one-third of the small entities subject to the proposed or final rule.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For manufacturers, Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small manufacturers.

#### *International Trade Impact Assessment*

Consistent with the Administration's belief in the general superiority, desirability, and efficacy of free trade, it is the policy of the Administrator to remove or diminish, to the extent feasible, barriers to international trade, including both barriers affecting the export of American goods and services to foreign countries and those affecting the import of foreign goods and services into the United States.

In accordance with that policy, the FAA is committed to develop as much as possible its aviation standards and practices in harmony with its trading partners. Significant cost savings can result from this, both to United States companies doing business in foreign markets, and foreign companies doing business in the United States.

This proposed rule is a direct action to respond to this policy by increasing the harmonization of the U.S. Federal Aviation Regulations with the European Joint Aviation

Requirements. The result would be a positive step toward removing impediments to international trade.

### **Federalism Implications**

The amended regulations proposed in this rulemaking would not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant preparing a Federalism Assessment.

### **International Compatibility**

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) standards and recommended practices to the maximum extent practicable. The FAA has determined that this proposed rule would not conflict with any international agreement of the United States.

### **Paperwork Reduction Act**

There are no new requirements for information collection associated with this proposed rule that would require approval from the Office of Management and Budget pursuant to the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)).

### **Regulations Affecting Intrastate Aviation in Alaska.**

Section 1205 of the FAA Reauthorization Act of 1996 (110 Stat. 3213) requires the Administrator, when modifying regulations in Title 14 of the CFR in a manner affecting intrastate aviation in Alaska, to consider the extent to which Alaska is not served by transportation modes other than aviation, and to establish such regulatory distinctions as he or she considers appropriate. Because this proposed rule would apply

to the certification of future designs of transport category airplanes and their subsequent operation, it could, if adopted, affect intrastate aviation in Alaska. The FAA therefore specifically requests comments on whether there is justification for applying the proposed rule differently to intrastate operations in Alaska.

## **INFORMATION CONTACT.**

### **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements

### **The Proposed Amendments**

Accordingly, the Federal Aviation Administration proposes to amend 14 CFR part 25 of the Federal Aviation Regulations (FAR) as follows:

## **PART 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES**

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

2. Section 25.731 would be amended by adding new paragraphs (d) and (e) to read as follows:

### **§ 25.731 Wheels**

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(d) Overpressure burst prevention. Means must be provided in each wheel to prevent wheel failure and tire burst that may result from excessive pressurization of the wheel and tire assembly.

(e) Braked Wheels. Each braked wheel must meet the applicable requirements of § 25.735.

3. Section 25.735 would be revised to read as follows:

### **§ 25.735 Brakes and braking systems**

(a) Approval. Each assembly consisting of a wheel(s) and brake(s) must be approved.

(b) Brake system capability. The brake system, associated systems and components must be designed and constructed so that:

(1) If any electrical, pneumatic, hydraulic, or mechanical connecting or transmitting element fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airplane to rest with a braked roll stopping distance of not more than two times that obtained in determining the landing distance as prescribed in § 25.125.

(2) Fluid lost from a brake hydraulic system, following a failure in, or in the vicinity of, the brakes, is insufficient to cause or support a hazardous fire on the ground or in flight.

(c) Brake controls. The brake controls must be designed and constructed so that:

(1) Excessive control force is not required for their operation.

(2) If an automatic braking system is installed, means are provided to:

(i) arm and disarm the system, and

(ii) allow the pilot(s) to override the system by use of manual braking.

(d) Parking brake. The airplane must have a parking brake control that, when selected on, will, without further attention, prevent the airplane from rolling on a dry and level paved runway when the most adverse combination of maximum thrust on one engine and up to maximum ground idle thrust on any, or all, other engine(s) is applied. The control must be suitably located or be adequately protected to prevent inadvertent operation. There must be indication in the cockpit when the parking brake is not fully released.

(e) Antiskid system. If an antiskid system is installed:

(1) It must operate satisfactorily over the range of expected runway conditions, without external adjustment.

(2) It must, at all times, have priority over the automatic braking system, if installed.

(f) Kinetic energy capacity. The design landing stop, the maximum kinetic energy accelerate-stop, and the most severe landing stop brake kinetic energy absorption requirements of each wheel and brake assembly must be determined. It must be substantiated by dynamometer testing that, at the declared fully worn limit(s) of the brake heat sink, the wheel and brake assemblies are capable of absorbing not less than these levels of kinetic energy. Energy absorption rates defined by the airplane manufacturer must be achieved. These rates must be equivalent to mean decelerations not less than 10  $\text{fps}^2$  for the design landing stop and 6  $\text{fps}^2$  for the maximum kinetic energy accelerate stop. The most severe landing stop need not be considered for extremely improbable failure conditions or if the maximum kinetic energy accelerate-stop energy is more severe. Design landing stop is an operational landing stop at maximum landing weight. Maximum kinetic energy accelerate-stop is a rejected takeoff for the most critical combination of airplane takeoff weight and speed. Most severe landing stop is a stop at the most critical combination of airplane landing weight and speed.

(g) Brake condition after high kinetic energy dynamometer stop(s). Following the high kinetic energy stop demonstration(s) required by paragraph (f) of this section, with the parking brake promptly and fully applied for at least three (3) minutes, it must be demonstrated that for at least five (5) minutes from application of the parking brake, no condition occurs (or has occurred during the stop), including fire associated with the tire or wheel and brake assembly, that could prejudice the safe and complete evacuation of the airplane.

(h) Stored energy systems. An indication to the flightcrew of the usable stored energy must be provided if a stored energy system is used to show compliance with paragraph (b)(1) of this section. The available stored energy must be sufficient for:

(1) At least six (6) full applications of the brakes when an antiskid system is not operating; and

(2) Bringing the airplane to a complete stop when an antiskid system is operating, under all runway surface conditions for which the airplane is certificated.

(i) Brake wear indicators. Means must be provided for each brake assembly to indicate when the heat sink is worn to the permissible limit. The means must be reliable and readily visible.

(j) Overtemperature burst prevention. Means must be provided in each braked wheel to prevent wheel failure and tire burst that may result from elevated brake temperatures. Additionally, all wheels must meet the requirements of § 25.731(d).

(k) Compatibility. Compatibility of the wheel and brake assemblies with the airplane and its systems must be substantiated.

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